ORGANIZATION

…IE PATENT COOPERATION TREATY (PCT)

H01S 5/0687 | A1

(11) International Publication Number: WO 00/54381

(43) International Publication Date: 14 September 2000 (14.09.00)

(21) International Application Number: PCT/SE00/00294

(22) International Filing Date: 15 February 2000 (15.02.00)

(30) Priority Data:
9900536-5 17 February 1999 (17.02.99) SE
9903039-7 27 August 1999 (27.08.99) SE

(71) Applicant *(for all designated States except US)*: ALTITUN AB [SE/SE]; Isafjordsgatan 9, S-164 40 Kista (SE).

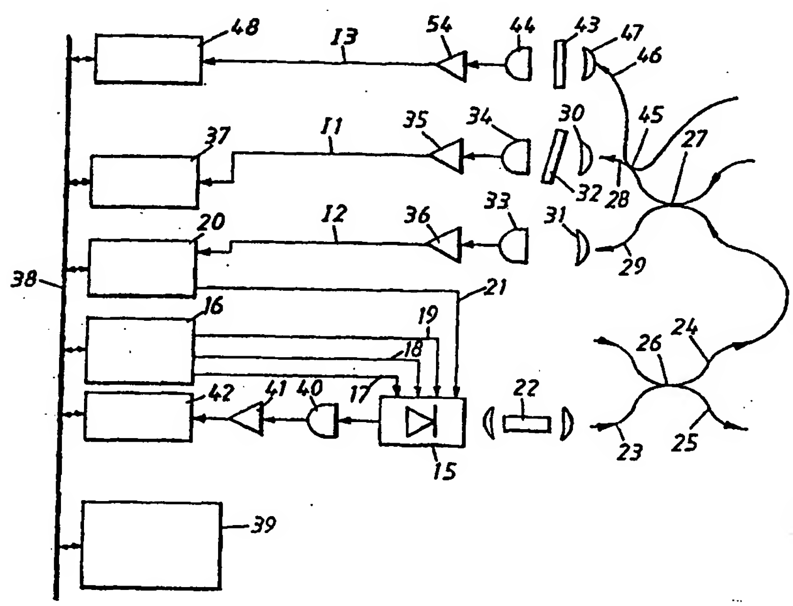
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: RENLUND, Markus [SE/SE]; Hjärnegatan 1, S-112 24 Stockholm (SE). ANDERSSON, Lars [SE/SE]; Kristinavagen 7, S-177 56 Jarfalla (SE).

(74) Agents: ÖRTENBLAD, Bertil et al.; Noréns Patentbyrå AB, Box 10198, S-100 55 Stockholm (SE).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: A METHOD OF CHARACTERISING A TUNEABLE LASER AND DETERMINING ACTUAL WAVELENGTH



(57) Abstract

A method of evaluating a tuneable laser (15) and determining suitable laser operation points, wherein the laser includes one or more tuneable sections in which injected current can be varied. The invention is characterised by leading part of the light emitted by the laser (15) to an arrangement that includes a first filter (32) in the form of a periodic filter which gives rise to a signal that varies periodically with wavelength, such as a Fabry-Perot filter (32), and a first detector (33) and a second detector (34) which are adapted to measure the power of the light and to deliver a corresponding detector signal (I1, I2); arranging the detectors relative to the periodic filter (32) such that the detector signals (I1, I2) will contain information relating at least to the wavelength of the detected light from a number of wavelengths given by the filter (32); arranging a second filter (43) parallel with the periodic filter (32), said second filter (43) being a filter whose response varies monotonically with the wavelength; leading the light transmitted through the second filter to a third detector (44) which delivers a detector signal (I3) corresponding to the power of the light and therewith also to wavelength; sweeping the currents through the tuning sections (17, 18, 19) such as to pass through different current combinations; measuring the ratio between the two detector signals (I1, I2) during said sweep; causing the third detector (44) to be controlled to sort out the relevant wavelength when the ratio between the detector signals (I1, I2) lies within a predetermined range and therewith signifies that the emitted light lies within one of a number of wavelengths given by the periodic filter (32); and by storing the tuning current control combination together with the wavelength concerned.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H01S 5/0687 — A1

(11) International Publication Number: WO 00/54381

(43) International Publication Date: 14 September 2000 (14.09.00)

(21) International Application Number: PCT/SE00/00294

(22) International Filing Date: 15 February 2000 (15.02.00)

(30) Priority Data:

9900536-5	17 February 1999 (17.02.99)	SE
9903039-7	27 August 1999 (27.08.99)	SE

(71) Applicant *(for all designated States except US)*: ALTITUN AB [SE/SE]; Isafjordsgatan 9, S-164 40 Kista (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: RENLUND, Markus [SE/SE]; Hjärnegatan 1, S-112 24 Stockholm (SE). ANDERSSON, Lars [SE/SE]; Kristinavagen 7, S-177 56 Jarfalla (SE).

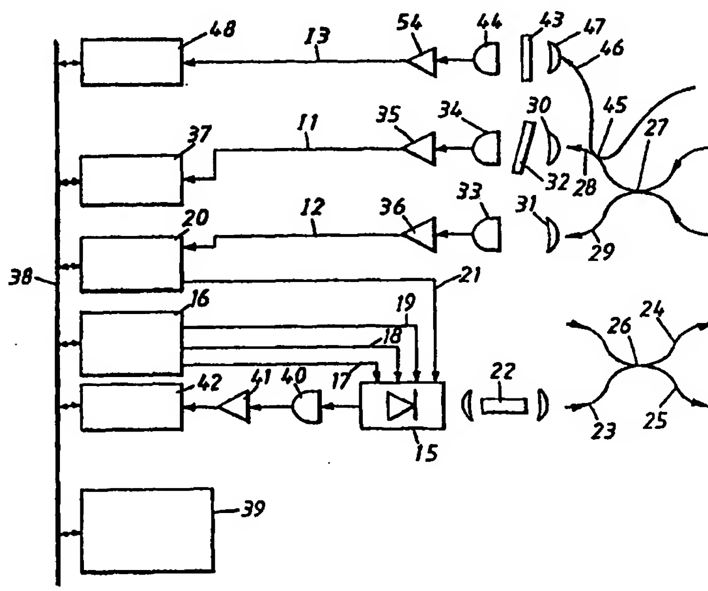
(74) Agents: ÖRTENBLAD, Bertil et al.; Noréns Patentbyrå AB, Box 10198, S-100 55 Stockholm (SE).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: A METHOD OF CHARACTERISING A TUNEABLE LASER AND DETERMINING ACTUAL WAVELENGTH

(57) Abstract



A method of evaluating a tuneable laser (15) and determining suitable laser operation points, wherein the laser includes one or more tuneable sections in which injected current can be varied. The invention is characterised by leading part of the light emitted by the laser (15) to an arrangement that includes a first filter (32) in the form of a periodic filter which gives rise to a signal that varies periodically with wavelength, such as a Fabry-Perot filter (32), and a first detector (33) and a second detector (34) which are adapted to measure the power of the light and to deliver a corresponding detector signal (I1, I2); arranging the detectors relative to the periodic filter (32) such that the detector signals (I1, I2) will contain information relating at least to the wavelength of the detected light from a number of wavelengths given by the filter (32); arranging a second filter (43) parallel with the periodic filter (32), said second filter (43) being a filter whose response varies monotonically with the wavelength; leading the light transmitted through the second filter to a third detector (44) which delivers a detector signal (I3) corresponding to the power of the light and therewith also to wavelength; sweeping the currents through the tuning sections (17, 18, 19) such as to pass through different current combinations; measuring the ratio between the two detector signals (I1, I2) during said sweep; causing the third detector (44) to be controlled to sort out the relevant wavelength when the ratio between the detector signals (I1, I2) lies within a predetermined range and therewith signifies that the emitted light lies within one of a number of wavelengths given by the periodic filter (32); and by storing the tuning current control combination together with the wavelength concerned.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

A METHOD OF CHARACTERISING A TUNEABLE LASER AND DETERMINING ACTUAL WAVE LENGTH

The present invention relates to a method for rapidly characterising a tuneable laser.

The method can be applied to evaluate and select lasers with respect to emitted wavelengths, and to systematically find good operation points.

Tuneable semiconductor lasers include several sections to which current is injected, these sections typically being three or four in number. The wavelength, power and mode purity of the lasers can be controlled by regulating the current injected into the various sections. Mode purity implies that the laser is at an operation point, i.e. at a distance from a combination of the drive currents where so-called mode jumps take place and where lasering is stable and sidemode suppression is high.

In the case of telecommunications applications, it is necessary that the laser is able to retain its wavelength to a very high degree of accuracy and over long periods of time, after having set the drive currents and the temperature. A typical accuracy in this respect is 0.1 nanometer and a typical time period is 20 years.

In order to be able to control the laser, it is necessary to map the behaviour of the laser as a function of the various drive currents. This is necessary prior to using the laser after its manufacture.

One problem is that lasers exhibit an hysteresis. This means that for a given drive current set-up, i.e. a given operation

point, the laser will deliver different output signals with respect to power and wavelength depending on the path through which the laser has passed with respect to the change in said drive currents in order to arrive at the operation point in question. Thus, a given drive current set-up will not unequivocally give the expected wavelengths or power in this case.

In the case of a tuneable laser, the wavelength of the light emitted is determined mainly by the current through or the voltage across the tuning sections. The power output is controlled by current to the gain section of the laser or by the voltage across said section.

All possible control combinations afforded by the tuning sections, or a subset of said sections, are investigated when characterising a laser. During the characterising process, the light emitted is studied with respect to wavelength and sidemode suppression and in controlling the gain section with regard to power adjustment.

The large number of possible control combinations, typically tens of billions, of which fewer than a hundred shall be selected, makes total mapping of the laser impossible in view of the large amount of data generated.

One method of characterising a laser is described in Swedish Patent No. 9900536-5. According to this patent publication, the hysteresis of the laser is also considered. The patent relates to a method of quickly sorting out control combinations that do not result in correct wavelengths.

The aforesaid patent relates to a method of evaluating a tuneable laser and of determining suitable operation points

for a laser that includes two or more tuneable sections in which injected current can be varied and of which at least one is a reflector section and one is a phase section. According to the patent, part of the light emitted by the laser is led to an arrangement that includes a Fabry-Perot filter and a first and a second detector, said detectors being adapted to measure the power of the light and to deliver a corresponding detector signal. The detectors are arranged relative to the Fabry-Perot filter such that the detector signals will contain information relating at least to the wavelength of the detected light from a number of wavelengths given by the filter. The currents through the tuning sections are swept so as to pass through different current combinations, the ratio between the two detector signals being measured during said sweeps. The current combination is stored when the ratio between the detector signals lies within a predetermined range that indicates that the light emitted lies within one of a number of wavelengths given by the Fabry-Perot filter.

The Fabry-Perot filter is adapted to have a certain given transmission for those wavelengths included in a so-called channel plan where each channel corresponds to a well-defined wavelength.

One problem with the invention according to the aforesaid prior patent publication is that no information is obtained as to which operation point belongs to which channel. It is therefore necessary to determine and sort the various operation points, which must be done manually and with conventional instruments.

This problem is solved by the present invention.

The present invention thus relates to a method of evaluating a tuneable laser and determining suitable laser operation points, wherein the laser includes one or more tuneable sections in which injected current can be varied, and wherein the invention is characterised by leading part of the light emitted by the laser to an arrangement that includes a first filter in the form of a periodic filter that gives rise to a signal which varies periodically with wavelength, such as a Fabry-Perot filter, and a first and a second detector which are adapted to measure the power of the light and to emit a corresponding detector signal; in that the detectors are arranged relative to the periodic filter such that said detector signals will include information relating to at least the wavelength of the detected light from a plurality of wavelengths given by the filter; in that the second filter is disposed parallel with the periodic filter and comprises a filter whose response varies monotonically with the wavelength, wherein the light transmitted through the second filter is led to a third detector which emits a detector signal corresponding to the power of the light and therewith wavelength; in that the currents through the tuning sections are swept so as to pass through different current combinations; in that the ratio between the two detector signals is measured during each sweep; in that when the ratio between the detector signals lies within a predetermined range indicating that the light emitted lies within one of a number of the wavelengths given by the periodic filter, the third detector is caused to detect so as to sort out the wavelength concerned; and in that the control combination of said tuning currents is stored together with the wavelength concerned.

The invention will now be described in more detail partly with reference to exemplifying embodiments thereof shown on the accompanying drawings, in which

- Figure 1 is a sectional view of a tuneable Grating Coupled Sampled Reflector (GCSR) laser;
- Figure 2 is a schematic block diagram illustrating an arrangement used in accordance with the invention;
- Figure 3 illustrates a monotonic filter;
- Figure 4 shows laser power as a function of the wavelength for a periodic filter; and
- Figure 5 shows laser power as a function of the wavelength of a monotonically varying filter.

A DBR laser includes three sections, namely a Bragg reflector 1, a phase section 2 and a gain section 3. Each section is controlled by injecting current into respective sections.

Figure 1 is a sectional view of a tuneable Grating Coupled Sampled Reflector (GCSR) laser. Such a laser includes four sections, namely a Bragg reflector 7, a phase section 8, a coupler 9 and a gain section 10. Each of the sections is controlled by injecting current into respective sections.

A DBR laser includes three sections, namely a Bragg reflector 1, a phase section 2 and a gain section 3. Each section is controlled by injecting current into respective sections.

A Sampled Grating DBR laser also has four sections of which the outer sections are Bragg reflectors and where a phase section and a gain section are situated therebetween.

These three laser types are common, although other types of lasers exist.

Although the invention is described below essentially with reference to a GCSR laser according to Figure 1, it will be understood that the invention is not restricted to any particular type of tuneable semiconductor laser but can be applied correspondingly with tuneable lasers other than those described.

The present invention relates to a method of evaluating tuneable lasers and determining suitable laser operation points. The laser may thus include one or more tuneable sections in which injected current can be varied in a known manner. The laser may be of the kind that includes at least one reflector section and one phase section. The laser may also be of the kind that includes only one tuning section, or of the kind with which the laser is tuned by some mechanism other than current injection in a reflector.

Figure 2 is a block diagram illustrating an arrangement used in accordance with the invention. The reference numeral 15 identifies a GCSR laser, while the reference numeral 16 identifies current generators for injecting current into the reflector section of the laser, phase section and coupler section respectively through a respective conductor 17, 18 and 19. The power of the laser is controlled by means of a power regulating circuit 20 via a conductor 21 leading to the laser gain section.

The laser emits light from the front mirror to a light conductor 23, for instance a light fibre, via a lens pack 22. This light conductor leads the light to a light splitter or divider 26 which switches part of the light to a second light conductor 24. The remainder of the light is led further in the conductor 25. The light splitter 26 switches, e.g., 10% of the light from the conductor 23 to the conductor 24.

The light conductor 24 leads the light to a second light splitter or divider 27 that functions to divide the light equally between two conductors 28, 29. A lens 30 and a lens 31 are disposed at respective ends of the light conductors. A Fabry-Perot filter 32 or some corresponding periodic filter is provided in the beam path downstream of the lens 30. The filter 32 is well known in the art and will not therefore be described in any great detail in this document. Fabry-Perot filters can be designed to exhibit a certain light transmission solely for certain wavelengths, normally wavelengths that are multiples of a given wavelength. The Fabry-Perot filter exhibits a deviating lower or higher transmission at other wavelengths. It will be understood that other periodic filters that have properties corresponding to those of a Fabry-Perot filter may be used instead.

Figure 4 illustrates schematically power downstream of the periodic filter as a function of wavelength.
A first detector 33 is provided downstream of the lens 31, and a second detector 34 is provided downstream of the Fabry-Perot filter. The detectors 33, 34 function to measure the power of the light and to send a corresponding detector signal to an A/D converter 37 via a respective amplifier 35, 36.

The A/D converter 37, the power regulating circuit 20 and the current generators 16 are all connected to microprocessor 39 via a data bus 38. The microprocessor is adapted to control the current generators and the power regulating circuit in a desired and well-known manner, in response to the signals from the A/D converter 37 and the power regulating circuit 20.

Part of the forwardly emitted light is conducted to the first detector 33 and also to the second detector 34 via the Fabry-Perot filter 32.

The currents are swept through the tuning sections 18, 19, 21 such as to pass through different current combinations. The ratio between the two detector signals I1 and I2 is measured during said sweeps.

When sweeping the currents through the tuning sections, the reflector current is the inner sweep variable. This means that the reflector current is swept for different combinations of other tuning currents while holding said currents constant. The reflector current is swept first in one direction and then in the opposite direction, back to its start value. For instance, the reflector current is swept from a zero value and up to its maximum value and then back down to zero.

By current control in the present document is meant that the current through the sections is controlled by current generators or, alternatively, that the current through the section is controlled by controlling the voltage across said sections.

In the case of the Figure 2 embodiment, the first detector, the second detector and the Fabry-Perot filter are placed in the proximity of the front mirror of the laser. Alternatively, these components may equally as well be placed in the proximity of the rear mirror of the laser, in which case light emitted from the laser rear mirror is used to determine the wavelength.

Furthermore, the Fabry-Perot filter and the first and the second detectors may be arranged relative to one another in a manner different to that shown in Figure 4, so as to detect at least wavelengths. The first detector and the second detector may be adapted to measure light transmitted through the Fabry-Perot filter and/or light reflected towards the Fabry-Perot filter, such as to detect wavelengths.

Those operation points that lie in the regions of hysteresis with respect to the reflector current or with respect to other tuning currents for those sections that exhibit hysteresis are non-preferred operation points for a laser in operation.

Communication lasers shall be adapted to operate at certain given wavelengths that are included in a so-called channel plan, where each channel corresponds to a well-defined wavelength. According to the invention, the Fabry-Perot filter 32 is adapted to have a certain given transmission for each wavelength included in the channel plan.

When the ratio between the detector signals I1/I2 from the detectors 32, 33 lies within a predetermined range implying that the light emitted lies within one of a number of wavelengths given by the Fabry-Perot filter and said ratio I1/I2 lies within said range for a given reflector current in both sweep directions of said current, the tuning current control combination is stored.

This range is given by the permitted channel width in the channel plan.

These control combinations thus fulfil the criteria that will result in desired wavelength and not in any hysteresis effect.

In certain cases, it is preferred that one or more other section tuning currents that exhibit an hysteresis effect, excluding the reflector current, are swept so as to determine whether or not hysteresis occurs in a contemplated operation point.

The aforesaid is also apparent from the above-mentioned patent publication.

According to the present invention, a second filter 43 is arranged parallel with the periodic filter 32. Half the light power in the light conductor 28 upstream of the lens 30 is suitably switched by a light splitter 45 to a light conductor 46 that conducts the light to the third filter 43 via a lens 47. The second filter 43 is a filter whose response varies monotonically with the wavelength. This is illustrated in Figure 5, where the transmitted power P is shown to vary monotonically with the wavelength. The light transmitted through the second filter is led to a third detector 44 which, via an amplifier 54, sends to an A/D converter 48 a detector signal I3 corresponding to the power of the light and therewith its wavelength. The A/D converter is connected to said data bus 38.

Figure 3 illustrates an example of a known monotonically varying filter. The filter is a dielectric wavelength-selective filter. The light is divided up upstream of the filter and each part of the light is led through glass 49, 50 on which a thin layer has been vaporised. After transmissions through the glass, the power is detected by means of

detectors 51, 52 and the output signals of respective detectors are passed to an operational amplifier 53 whose output signal is a measurement of the wavelength.

Another example of the second filter is implementation of the wavelength selectivity of a light splitter in the form of a fibre coupler.

As before mentioned, the currents are swept through the tuning sections 17, 18, 1 and the ratio between the two detector signals I1, I2 is measured during the sweep. When the ratio between the detector signals (I1, I2) lies within a predetermined range implying that the light emitted lies within one of a number of the wavelengths given by the periodic filter 32, the third detector 44 is caused to detect so as to sort-out the wavelength concerned. The tuning current control combination is herewith stored together with the wavelength concerned.

To this end, I1, I2 and I3 are conducted to the microprocessor via the data bus, said processor being adapted to evaluate operation points and wavelengths and to store the same. The microprocessor is later used to control the laser to operate at a desired wavelength.

The signal from the third filter thus provides a clear measurement of the wavelength of the laser. However, the accuracy of this measurement is not sufficient on its own to evaluate the different operation points of the laser, although it is sufficient to identify positively each peak in the periodic filter. Thus, it is possible to determine all operation points that give the desired wavelengths.

The invention thus enables the laser to be characterised by very rapid measurements of the optical power that passes the two filters and to determine automatically the laser operation points for all desired channels in the channel plan.

According to one preferred embodiment of the invention, the signal I2 from the first detector 33 is delivered to the power regulating circuit 20. This circuit is adapted to control the laser to emit light with a constant output power. This enables the ratio I1/I2 to be easily followed in determining possible operation points.

According to another preferred embodiment, a monitor diode is placed on the side of the laser opposite to the side on which the first and the second detectors are placed, said monitor diode being caused to measure the light emitted by the laser. The signal from the detector 40 is passed via an amplifier 41 to an A/D converter 42 whose output signal is sent to the microprocessor 39. According to this embodiment, one or more tuning currents are chosen such as to minimise the ratio between the power of the rearwardly emitted light and the power of the forwardly emitted light, whereby there is chosen an optimal operation point from said possible operation points in respect of a channel.

It will be understood that the aforedescribed use of a Fabry-Perot filter enables all those control combinations that do not fulfil the criterion of requiring the ratio between the currents I1/I2 to lie within a certain given interval to be sorted out.

Furthermore, for communications purposes it suffices to identify one control combination per wavelength in the

channel plan that lies in a range in which the laser does not exhibit hysteresis.

The present invention thus solves the problem mentioned in the introduction.

Although the invention has been described with reference to various exemplifying embodiments thereof and in conjunction with a GCSR laser, it will be understood that the structural design of the described arrangement can be varied whilst achieving the same result. It will also be understood that the invention can be applied with lasers other than GCSR lasers.

The present invention is therefore not restricted to the aforedescribed embodiments thereof, since variations and modifications can be made within the scope of the following Claims.

CLAIMS

1. A method of evaluating a tuneable laser (15) and determining suitable laser operation points, wherein the laser includes one or more tuneable sections in which injected current can be varied, **characterised** by leading part of the light emitted by the laser (15) to an arrangement that includes a first filter (32) in the form of a periodic filter which gives rise to a signal that varies periodically with wavelength, such as a Fabry-Perot filter (32), and a first detector (33) and a second detector (34) which are adapted to measure the power of the light and to deliver a corresponding detector signal (I1, I2); arranging the detectors relative to the periodic filter (32) such that the detector signals (I1, I2) will contain information relating at least to the wavelength of the detected light from a number of wavelengths given by the filter (32); arranging a second filter (43) parallel with the periodic filter (32), said second filter (43) being a filter whose response varies monotonically with the wavelength; leading the light transmitted through the second filter to a third detector (44) which delivers a detector signal (I3) corresponding to the power of the light and therewith also to wavelength; sweeping the currents through the tuning sections (17, 18, 19) such as to pass through different current combinations; measuring the ratio between the two detector signals (I1, I2) during said sweep; causing the third detector (44) to be controlled to sort out the relevant wavelength when the ratio between the detector signals (I1, I2) lies within a predetermined range and therewith signifies that the emitted light lies within one of a number of wavelengths given by the periodic filter (32); and by storing the tuning current control combination together with the wavelength concerned.

2. A method according to Claim 1, **characterised** in that when the currents through the tuning sections (17, 18, 19) are swept so as to pass through different current combinations, the reflector current (17) is caused to be the inner sweep variable which is swept in one direction and then in an opposite direction back to its start value; and in that when said ratio lies within said predetermined range for a given reflector current in both sweep directions of said current, the tuning current combination and wavelength are stored.

3. A method according to Claim 1 or 2, **characterised** in that the periodic filter (32) has a given transmission for each wavelength included in a channel plan that includes desired wavelengths and has a transmission which deviates therefrom in respect of other wavelengths.

4. A method according to Claim 1, 2 or 3, **characterised** by delivering the signal from a detector (33) at the front mirror of the laser to a power regulating circuit (20) which is adapted to control the laser (15) so as to emit light with a constant output power from the front mirror.

5. A method according to Claim 1, 2, 3 or 4, **characterised** by causing a monitor diode (40) placed on the side of the laser (15) opposite to that side on which the first (32) and the second (33) detectors are placed to measure the light emitted by the laser; and adjusting one or more of the tuning currents so as to minimise the ratio between the power of the rearwardly emitted light and the power of the forwardly emitted light, therewith optimising an operation point for the laser (15).

6. A method according to Claim 1, 2, 3, 4 or 5, **characterised** by sweeping one or more tuning currents to sections that exhibit an hysteresis effect, excluding the reflector current, so as to determine whether or not hysteresis occurs in a contemplated operation point.

7. A method according to Claim 1, 2, 3, 4, 5 or 6, **characterised** by measuring the wavelength transmitted by the laser (15) in a number of the possible operation points taken out until one operation point has been obtained for each desired wavelength, and storing the control combination for each operation point.

Fig. 1

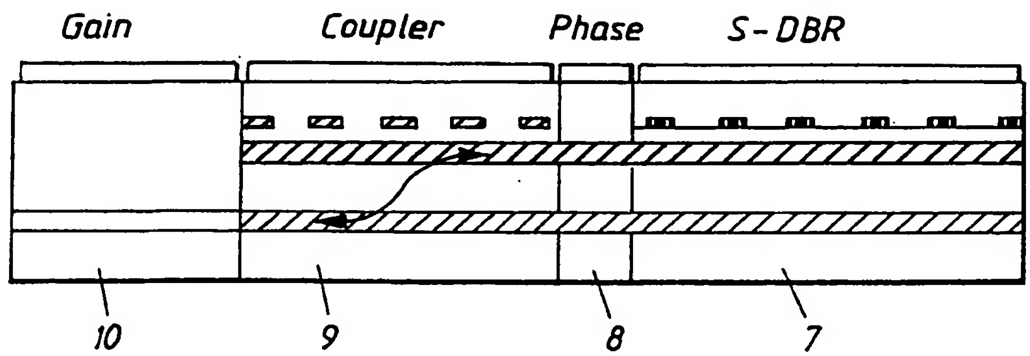

Gain
Coupler
Phase
S-DBR
10
9
8
7

Fig. 2

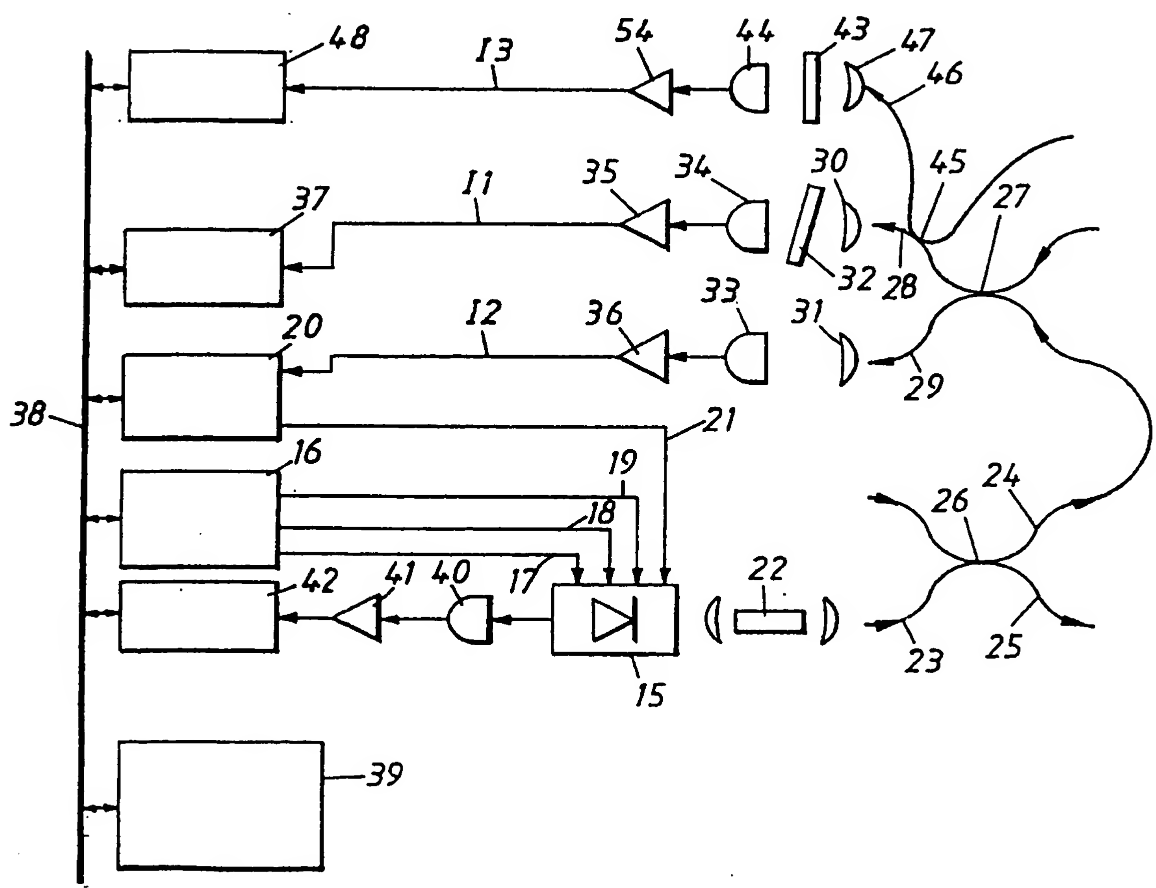

48
13
54
44
43
47
46
37
11
35
34
30
45
27
32
28
20
12
36
33
31
29
38
21
16
19
18
24
26
42
41
40
17
22
15
23
25
39

Fig. 3

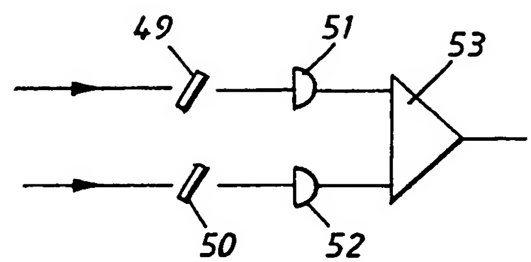


Fig. 4

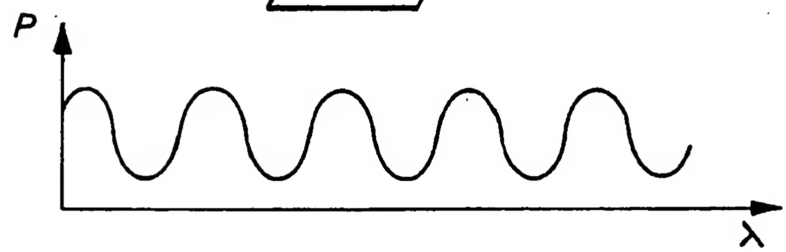
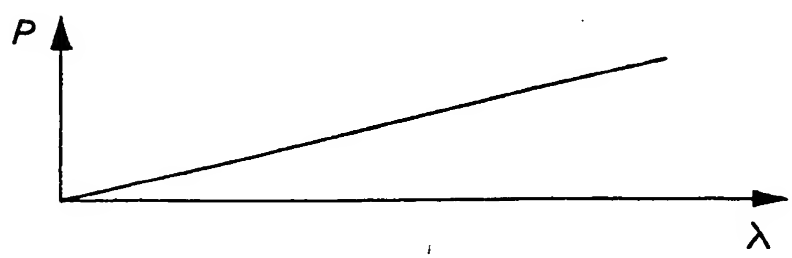


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00294

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01S 5/0687

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01S, H01L, G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0529732 A1 (N.V. PHILIPS GLOEILAMPENFABRIEKEN), 3 March 1993 (03.03.93), see whole document --	1-3,5-6
Y	EP 0774684 A2 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.), 21 May 1997 (21.05.97), page 3, line 39 - line 44; page 26, figure 33 --	1-3,5-6
Y	US 4792956 A (GEORGE W. KAMIN), 20 December 1988 (20.12.88) --	5-6
Y	GB 2163286 A (INTERNATIONAL STANDARD ELECTRIC CORPORATION (USA-DELAWARE)), 19 February 1986 (19.02.86) --	1-3,5-6

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" erlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2000	29 -06- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer MÅNS MARKLUND/EE Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00294

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,Y	Optical Fiber Communication Conference, 1999 OFC/IOOC'99. Technical Digest, 1999 (21-26/2) San Diego, vol 2, p 137-139. see whole document	1-6

--

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/12/99

International application No.
PCT/SE 00/00294

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0529732 A1	03/03/93	DE 69200654 D,T	24/05/95
		JP 5335674 A	17/12/93
		US 5359613 A	25/10/94
EP 0774684 A2	21/05/97	JP 9197457 A	31/07/97
		US 5835650 A	10/11/98
		JP 10041589 A	13/02/98
US 4792956 A	20/12/88	CA 1315332 A	30/03/93
		DE 3715101 A,C	19/11/87
		FR 2598860 A,B	20/11/87
		GB 2190783 A,B	25/11/87
		IL 82315 D	00/00/00
		IT 1210728 B	20/09/89
		IT 8767408 D	00/00/00
		JP 1877244 C	07/10/94
		JP 5087156 B	15/12/93
		JP 62273788 A	27/11/87
GB 2163286 A	19/02/86	DE 3421851 A,C	19/12/85
		ES 544112 A	16/12/86